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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 10/005,000

Applicant: James H Lee

Filed: 12/07/2001

Title: A COGENERATION SYSTEM FOR A FUEL CELL

Art Unit: 1754

Examiner: Alejandro, Raymond

Attorney Docket No.: H-204145

APPEAL BRIEF

Sir:

This Appeal Brief is being filed in response to the final Office Action of June 29, 2004 and in support of reversing the Examiner's rejection of claims 1-2 and 10 involved in this appeal. One copy of this Appeal Brief is being supplied.

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I. REAL PARTY IN INTEREST

The real party in interest is General Motors Cooperation.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

III. STATUS OF THE CLAIMS

<u>Claim(s)</u>	<u>Status</u>
1-2 and 10	Rejected
7-8 and 11	Indicated as allowable

Claims appealed

Claims 1-2 and 10 are being appealed.

IV. STATUS OF AMENDMENTS

In the advisory action of September 13, 2004, the Examiner indicted that claims 7-8 and 11 would be allowable if rewritten or amended to overcome the lack of antecedent basis in independent claim 7 which recites the limitation "wherein the condenser fans" in line 12 (step f). Applicant amended independent claim 7 in a manner that is believed to remove the lack of antecedent basis issue in the amendment after final dated October 18, 2004. Applicants believe that the amendment after final has been entered.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The claim subject matter in general includes a fuel cell process using a Rankine cycle to produce shaft work to operate a fuel cell system component. The shaft work may be used to drive an air compressor to deliver compressed air to a fuel cell system component. The steps of the Rankine cycle include pumping an organic based liquid working fluid to an elevated pressure; flowing the organic base liquid working fluid through a heat exchanger 300 in a fuel cell stack 10; heating the organic base liquid working fluid to a high temperature and high-pressure gas; expanding the high temperature and high-pressure gas through an expander 116 to produce shaft work; using the shaft work to drive an air compressor 21 for compressing air and delivering compressed air to a fuel cell component 10; and removing energy from the gas to change the gas to the organic based liquid working fluid, as recited in independent Claim 1. See the instant application at Page 3, lines 14-24, Page 9 lines 10 - Page 10 lines 1-15, Figures 1-2.

Dependant Claim 2 recites a process as set forth in Claim 1 further comprising using the shaft work to drive a pump 1 or 2 for pressurizing and delivering cooling fluid to a fuel cell system component. See Figure 1.

Dependent Claim 10 recites a process as set forth in Claim 1 wherein the organic base liquid cooling fluid comprises  $\text{CClF}_2\text{CClF}_2$ . See the instant application at Page 7, lines 9-11. Applicant notes that the formula recited in Claim 10 may include a typographical error in that Chlorine may be represented incorrectly as CI in the formula and should be represented by

“Cl.” The formula was correct in the Request for Reconsideration filed August 30, 2004 but was transposed incorrectly in the Amendment After Final filed October 18, 2004.

**VI. GROUND FOR REJECTION TO BE REVIEWED ON APPEAL**

Claim 1 stands rejected under 35 USC 102(b) as being anticipated by Bloomfield US patent number 3,982,962.

Claim 2 stands rejected under 35 USC 103(a) as been unpatentable over Bloomfield US patent number 3,982,962 as applied to Claim 1 and further in view of Ennis et al US patent number 5,938,975.

Claim 10 stands rejected under 35 USC 103(a) as being unpatentable over Bloomfield US patent number 3,982,962 as applied to Claim 1, and further in view of Keller US patent number 3,968,999.

**VII. ARGUMENT**

**Claim 1 stands rejected under 35 USC 102(b) as being anticipated by Bloomfield US patent number 3,982,962**

**BLOOMFIELD DOES NOT IDENTICALLY DISCLOSE THE CLAIMED INVENTION AS REQUIRED UNDER 35 USC 102**

Applicants’ independent Claim 1 on appeal recites “pumping an organic based liquid working fluid to an elevated temperature, flowing the organic based liquid working

through a heat exchanger in a fuel cell stack.” Such a limitation, in combination with other limitations of Claim 1, is not identically disclosed by Bloomfield or any of the other references of record. The Examiner has taken the position that a hydrocarbon fuel becomes mixed with water or steam in the Rankine cycle loop. However, the Examiner’s reading of the Bloomfield reference is in error. The only place that Bloomfield teaches that steam and a hydrocarbon should be mixed is in line 66, which leads to the steam reformer 18 of the Bloomfield reference. The Board’s attention is respectfully directed to Bloomfield’s 962, column 5, lines 39-46, which states:

“the superheated steam leaves the heat exchanger 72 and is delivered to a valve 96 via a conduit 98. The valve 96 permits the amount of steam necessary for the steam reforming reactor 18 to pass into the conduit 66 where it mixes with unprocessed fuel at 64 as here above explained. The remainder of the superheated steam is delivered into the turbine 40 via conduit 100.”

As such, only superheated steam is delivered into the turbine 40 and thus back into the Rankine cycle loop. The Board’s attention is also respectfully directed further to Bloomfield, column 5, lines 28-32 which states in part, “water is delivered into pump 90 via conduit at 92 and is delivered into thermal heat exchange relationship with a stack via conduit 94...”. As such, Bloomfield teaches that only water is delivered to the stack.

Again, Applicants independent Claim 1 recites “pumping an organic based liquid working through to an elevated temperature, flowing the organic based liquid working fluid through a heat exchanger and a fuel cell stack.” Bloomfield actually teaches away from Applicant’s independent claim 1 by teaching that water should be pumped from pump 90 via line

94 into the heat exchanger of the fuel cell.

The Board's attention is also respectfully directed to Bloomfield, column 6, lines 9-17 and Figure 2. Even where Bloomfield suggests using a Rankine cycle loop with a fluid other than water, such as a refrigerant, the Rankine cycle loop does not include a fuel cell. As shown in Figure 2 of Bloomfield, a separate Rankine cycle loop is provided that does not include a fuel cell. A separate steam loop (lines 204, 208) is provided (as shown in Figure 2) wherein water is pumped by line 210 into a heat exchanger 25 in the fuel cell 12. Again Bloomfield teaches away from Applicant's claimed invention. Contrary to the Examiner's assertion, in Bloomfield the anode exhaust 28 from the fuel cell stack 12 does not include an organic working liquid fluid or an organic cooling fuel. Fuel cells are designed so that hydrogen is delivered to the fuel cell with trace amounts of carbon dioxide if a fuel reforming plant, such as that used to reform gasoline, is connected to the fuel cell stack. In fact, the presence of hydrocarbon fuels in the cathode gas or anode gas will actually poison the catalyst utilized in the fuel cell. The Board's attention is directed to Bloomfield, column 4, lines 58-63 which states "the anode effluent gas stream leaves the anode gas base 36 by means of conduit 78, passes through a condenser wherein water is recovered there from, and then is fed into the reactor burner 20 via conduit 82 along with compressed air from the air box 46 via conduit at 48." Bloomfield, thus teaches recovering water from the anode effluent gas stream, but nowhere is it stated that the water includes any type of organic working fluid or organic cooling fluid as required by Applicant's independent Claim 1. No prima facie case of anticipation has been established.

**Claim 2 stands rejected under 35 USC 103(b) as unpatentable over Bloomfield 3,982,962 as applied to Claim 1, and further in view of Ennis et al US patent number 5,938,975**

**THERE IS NO SUGGESTION TO USE THE TURBINE OF ENNIS ET AL IN A RANKINE CYCLE LOOP THAT INCLUDES A FUEL CELL**

Claim 2 recites a process as set forth in Claim 1 further comprising “using the shaft work to drive a pump for pressurizing and delivering cooling fluid to a fuel cell system component”. The Examiner rejected Claim 2 on the basis that the examiner believes that Ennis et al discloses that shaft work of a turbine can be for electrical generation only, or can also include work to operate one or more compressors or pumps. The Examiner maintains it would have been obvious to employ the shaft work to drive a pump of Ennis et al in the process of Bloomfield because the Examiner maintains that Ennis et al teaches that shaft work of the turbine can be used to operate pumps. However, the Board’s attention is respectfully directed to Ennis et al, column 22, lines 39-44 which discloses that track 1 delivers 2 moles of fuel cell 500 (preferably solid oxide fuel cells) delivering power and high pressure steam into combustor 501 which empowers turbine 502. Thus, Ennis et al teaches that the fuel cell and the combustor powers the turbine 502. There is no suggestion that the turbine 502 of Ennis et al should be used in a fuel cell system including expanding high temperature and high-pressure gas produced from an organic based liquid working fluid (wherein the organic based working liquid fluid has been flown through a heat exchanger in a fuel cell stack) through an expander to produce shaft work. In fact, Ennis et al includes a fuel cell 500 does not suggest flowing fuel cell cooling fluid through the turbine 502. Ennis et al certainly not disclose or suggest using a Rankine cycle loop

that includes a fuel cell system. The rejection, and the disclosures of the references, fails to provide the suggestion and/or the motivation necessary to modify the references relied on to arrive at Applicant's claimed invention as set forth in independent Claim 2. No prima facie case of obviousness has been established.

**Claim 10 stands rejected under 35 USC 103(a) as being unpatentable over Bloomfield US patent number 3,982,962 as applied to Claim 1 further in view of Keller US patent number 3,968,999**

**KELLER IS NON-ANALOGOUS ART**

Applicants' dependent Claim 10 recites a process as set forth in Claim 1 "wherein the organic based liquid cooling fluid comprises  $\text{CClF}_2\text{CClF}_2$ ." The Examiner has taken the position that Keller discloses that halo-substituted hydrocarbons like the Freons such as dichlorotetrafluoroethane are suitable refrigerants for the standard heat exchange apparatus employed in refrigeration plants so as to cool methanol. The Examiner maintains that it would have been obvious to a person of ordinary skill in the art to use the specific cooling fluid of Keller in the fuel cell system of Bloomberg as Keller discloses that halo-substituted hydrocarbons are suitable refrigerants. However, Keller relates to a method of making fuels from arctic environments. Applicants maintain that Keller is not analogous art. A person working on fuel cell systems and problems related thereto such as improving the energy efficiency of the fuel cell system, would not look to Keller to find answers. Since Keller is not analogous art, the rejection is improper. No prima facie case of obviousness has been established.

Even if Keller is analogous art, which Applicants deny, Keller discloses the use of the specific organic working fluid of Applicants' dependent claim 10 is a refrigerant. There is no suggestion that the specific claimed organic working fluid should be utilized in a Rankine cycle loop that includes a fuel cell. Even if there was some suggestion to combine the specific organic working fluid disclosed in Keller with Bloomfield, the results still will not be Applicants' claimed invention as set forth in dependent claim 10. Again, at most Bloomfield' 962 discloses the use of a Rankine cycle loop with an organic fluid but does not teaches that a fuel cell stack should be in the loop. See Bloomfield, Figure 2. No prima facie case of obviousness has been established with respect to defendant claim 10.

VIII. CONCLUSION

Bloomfield does not identically disclose a process including a Rankine cycle that includes a fuel cell stack with a heat exchanger and an organic based liquid working fuel flowing through the heat exchanger. Ennis et al discloses the use of a fuel cell and a combustor to power a turbine, and there is no suggestion or motivation supplied they would make it obvious to a person of ordinary skill in the art to utilize the turbine of Ennis et al in the Rankine cycle loop of Bloomfield. And even if there were some suggestion to so combine, the result would not be Applicants' claimed invention as set forth in Claim 1 because Bloomfield does not disclose or suggest a Rankine cycle loop that includes a fuel cell in the loop. Finally, Keller is simply is not analogous art.

In view of the above argument, Applicants' respectfully request the Board to reverse the reject of the claims now in the case and instruct the examiner to send the case to issue.

Respectfully submitted



Cary W. Brooks - Attorney  
Reg. No. 33,361  
(313) 665-4717

## IX. CLAIMS APPENDIX

Claim 1. A process comprising:

pumping an organic based liquid working fluid to an elevated pressure,

flowing the organic based liquid working fluid through a heat exchanger in a fuel cell stack;

heating the organic based liquid working fluid to a high temperature and high-pressure gas,

expanding the high temperature and high-pressure gas through an expander to produce shaft work,

using the shaft work to drive air compressor for compressing air and delivering compressed air to a fuel cell system component;

and removing energy from the gas to change the gas to the organic based liquid working fluid.

Claim 2. A process as set forth in claim 1 further comprising using the shaft work to drive a pump for pressurizing and delivering cooling fluid to a fuel cell system component.

Claim 10. A process as set forth in claim 1 wherein the organic based liquid cooling fluid comprises  $CClF_2$   $CClF_2$ .

## X. EVIDENCE APPENDIX

Copies of the following evidence that has been entered and is relied on in this Appeal are:

1. Bloomfield US patent number 3,982,962;
2. Ennis et al US patent number 5,938,975; and
3. Keller US patent number 3,968,999.

## **XI. RELATED PROCEEDING APPENDIX**

There are no related decisions rendered by a Court or the Board and any appeal or interference.